Parametric City Scale Energy Modeling Perspectives on using Termite in city scaled models

Negendahl, Kristoffer; Nielsen, Toke Rammer

Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

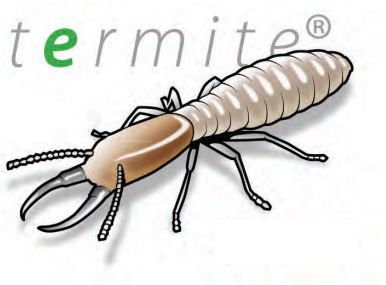
Parametric City Scale Energy Modeling

Perspectives on using Termite in city scaled models

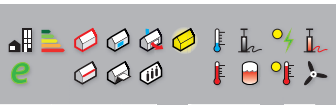
CITIES - Centre for IT
Intelligent Energy
Systems in Cities

DTU

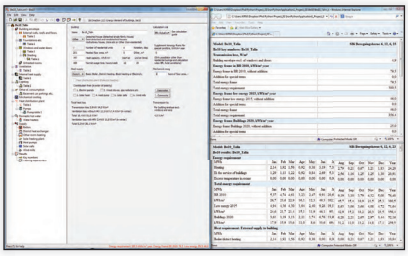
Termite is a parametric tool using the Danish building performance simulation engine Be10 written for the Grasshopper3D/Rhino3D environment. The tool Be10 is originally intended for building energy frame calculations and is required by Danish law when constructing new buildings. Termite opens up for fully parametric district- and city-size simulations of yearly building energy consumption with the same precisions of energy use as the tool simulates on each and every building. The poster demonstrates some of the parametric flexibilities in using Termite e.g. planning for optimal synergetic envelope requirements, placing solar energy production facilities etc.



TERMITE MAKES PEOPLE WORK TOGETHER
TO DESIGN BETTER BUILDINGS

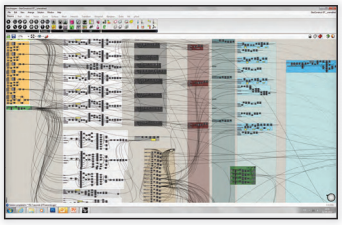


Termite is able to simulate the dynamics of building energy consumption over the year, which incluedes thermal transport, natural and mechanical ventilation, cooling and heating systems, heatpumps, solar cells and much more.

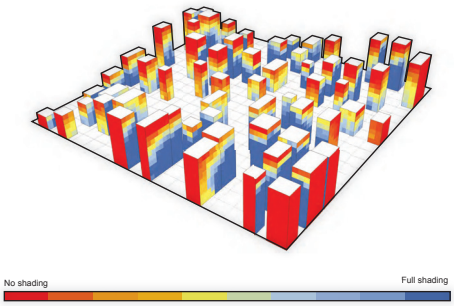


Be10 is a mono-zone, monthly based building performance simulation tool based on the Danish national energy standards of BR10

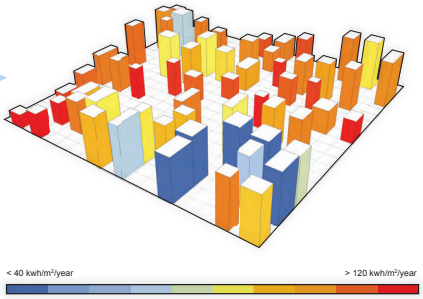
Termite uses the calculation engine of Be10 that accepts every input as a parametric varible in the programmable scripting environment of Grasshopper. Basically all geometric relationships can be modelled and visualized in the CAD environment of Rhino, while user defined algorithms can handle any system setting and input in Be10. While the tool is originally intended to be used in calculating the energy consumption of single buildings, Termite open up for multiple building simulations, thus providing a very efficient tool for city scale energy analysis.



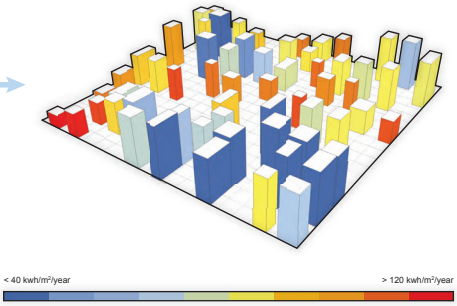
Termite is built by Ph.D candidate Kristoffer Negendahl in collaboration with Grontmij Architectural Engineering Denmark in the quest for qualifying sustainable buildings, districts and cities in the early stages of the design process.



This illustration is showing the self shading mechanisms in a fairly condensed city scape. The shading is calculated with an isovist-method based on C. Reinhart insolation distribution used in Radiance. The shadow effects are then used by Termite in calculating the monthly heat gain through window openings.



Termite can be used to calculate the monthly and yearly energy consumption in kWh/m², here displayed as a colour of building energy consumption. The entire city site is simulated within 5 seconds on an ordinary desktop machine, thus making the tool ideal for parametric design exploration purposes.



Fundamental changes in heating strategies and ventilation requirements can lead to very different energy consumption. Here is the district heating exchanger efficiency improved by 10% and criteria on window g-values is changed in all buildings.

Termite provides very detailed toolsets to model and analyze large scale building energy problems. Effects from building-to-building relationships can be defined by custom user-algorithms with Grasshopper while utilizing Termite to provide valid feedback of each building energy production and consumption. Energy reductions/increases can easily be visualized and Termite may be used as an effective tool for energy planning purposes.

Ph.D student Kristoffer Negendahl
Supervisor Toke Rammer Nielsen

Contact: krnj@byg.dtu.dk | +45 2670 4550

Section for Building Energy
Department of Civil Engineering

termite® Architectural Engineering Grontmij

CITIES
Centre for IT Intelligent Energy Systems